

Claims

1. A method of manufacturing a ceramic device comprising:
 - transporting ceramic tape in a green state into the proximity of a first forming element;
 - fixing a first end of said tape with respect to said first forming element;
 - moving said tape and first forming element relatively to each other in a motion including simultaneously rotational and translational movements, thus winding said tape around said first forming element;
 - removing said fixing of a first end thereby allowing separation of said tape and first forming element to generate a helically wound pre-formed tape;
 - fixing at least one end of said pre-formed tape with respect to a second forming element; and
 - moving said pre-formed tape and second forming element relatively to each other in a motion including at least a rotational movement, thus winding said pre-formed tape around said second forming element.
2. The method of claim 1, further comprising, during the step of moving said tape and first forming element relatively to each other, continuously pressing said tape onto said first forming element at a zone where said tape first contacts said first forming element.
3. The method of claim 2, further comprising, during the step of moving said tape and first forming element relatively to each other, exerting a force on the edge of the tape at a zone where said tape first contacts the first forming element to prevent slippage of said tape relative to said first forming element.

4. The method of any one of the preceding claims, further comprising, between the step of moving said tape and first forming element relatively to each other and the step of removing said fixing of a first end, closing a second clamping element around the first end of the tape.

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5. The method of any one of the preceding claims, wherein the step of separating said tape and first forming element comprises moving the first forming element relatively to an edge holding back the pre-formed tape.

10 6. The method of any one of the preceding claims, wherein, during the step of moving said pre-formed tape and second forming element relatively to each other, the pre-formed tape is held at both ends using clamping elements, one of said clamping elements fixing one end of said pre-formed tape with respect to the second forming element, the other clamping element performing a relative rotational movement around
15 said second forming element.

7. The method of any one of the preceding claims, further comprising the steps of removing the fixing with respect to the second forming element and transferring the wound pre-formed tape onto a support structure; and
20 placing said support structure into environment for drying.

8. The method of any one of the preceding claims, wherein the tape is handled by pneumatically operated devices.

25 9. The method of any one of the preceding claims, wherein the step of moving said tape and first forming element relatively to each other comprises rotating the first forming element and translating the unwound portion of the tape towards the first

-10-

forming element.

10. The method of claim 9, wherein the step of moving said tape and first forming element relatively to each other further comprises translating the first forming element 5 along an axis about which the tape is wound.

11. The method of any one of the preceding claims, wherein, in the step of moving said tape and first forming element relatively to each other, the tape is wound helically around the first forming element.

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12. The method of any one of the preceding claims, wherein the first forming element is cylindrical.

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13. The method of any one of the preceding claims, wherein the tape comprises layers of electro-active material.

14. An apparatus for manufacturing a ceramic device from tape in a green state, the apparatus comprising

a first forming element;

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a first clamping system for fixing a first end of said tape with respect to said first forming element;

a first mechanism for moving said tape and first forming element relatively to each other in a motion including simultaneously rotational and translational movements, thus winding said tape around said first forming element to form a preformed tape;

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a second forming element;

a second clamping system for fixing at least one end of said pre-formed tape with respect to said second forming element; and

-11-

a second mechanism for moving said pre-formed tape and second forming element relatively to each other in a motion including at least a rotational movement, thus winding said pre-formed tape around said second forming element.

5 15. The apparatus of claim 14, wherein the first clamping system includes a spring-loaded surface that in operation continuously presses the tape onto said first forming element at a zone where said tape first contacts said first forming element.

10 16. The apparatus of claim 15, wherein the spring-loaded surface is combined with a force-transmitting member adapted to contact the edge of the tape at a zone where said tape first contacts the first forming element to prevent slippage of said tape relative to said first forming element.

15 17. The apparatus of any one of claims 14 to 16, further comprising a stripping edge making contact to the first forming element to separate said first forming element and the pre-formed tape.

20 18. The apparatus of any one of claims 14 to 17, wherein the second clamping system includes a first clamping element for fixing a first end of the tape to the second forming element and a second clamping element for fixing the other end of the tape, the second mechanism being arranged to relatively rotate the second clamping element around said second forming element.

25 19. The apparatus of claim 18, further comprising one or more saggars having recesses adapted to support the formed tape during drying.

20. The apparatus of any one of claims 14 to 19, wherein the clamping devices are

-12-

pneumatically operated.

21. The apparatus of any one of claims 14 to 20, wherein the first forming element is a cylindrical rod.

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22. The apparatus of any one of claims 14 to 21, wherein the first mechanism comprises a rotary drive arranged to rotate the first forming member and a conveyor system arranged to translate the tape towards the first forming member.

10 23. The apparatus of claim 22, wherein the first mechanism further comprises a linear drive arranged to translate the first forming member along an axis about which the tape is wound.

15 24. A ceramic structure made using methods or apparatus in accordance with any of preceding claims.

25. The ceramic structure of claim 24 being an electro-active ceramic structure.